CONDITION OF DEMERSAL SHELF ROCKFISH STOCKS IN THE EASTERN GULF OF ALASKA AS ASSESSED IN 1988

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STATUS OF DEMERSAL SHELF ROCKFISH STOCKS IN THE EASTERN GULF OF ALASKA AS ASSESSED IN 1988

INTRODUCTION

Rockfishes of the genus Sebastes are found in nearshore waters and along the continental slope of the northeast Pacific Ocean. Fishes in the demersal shelf rockfish assemblage includes ten species of nearshore rockfishes in Alaskan waters (Table 1).

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Table 1. Rockfish which are included in the demersal shelf rockfish assemblage in the Gulf of Alaska.

Common Name	Scientific Name
Bocaccio	Sebastes paucispinus
Canary rockfish	S. pinniger
China rockfish	S. nebulosus
Copper rockfish	S. caurinus
Quillback rockfish	S. maliger
Rosethorn rockfish	S. helvomaculatus
Silvergray rockfish	S. brevispinis
Tiger rockfish	S. nigrocinctus
Yelloweye rockfish	S. ruberrimus
Redstripe rockfish	S. proriger

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These fishes have been landed incidental to other groundfish fisheries in Southeastern Alaska since the turn of the century. Some bycatch was also landed by foreign trawlers targeting on slope rockfish in the eastern Gulf during the 1960's and through the mid-1970's. In 1979 a small shore-based rockfish fishery began in southeast Alaska. This fishery targets primarily on the nearshore bottom-dwelling component of the rockfish complex. This directed fishery expanded from 160 mt landed in 1982 to over 1,225 mt landed in 1987.

Prior to 1987 demersal shelf rockfish were grouped with the "other rockfish" complex for fisheries management in the Exclusive Economic Zone (EEZ). However, in 1987 the nearshore or shelf rockfish component was identified as a separate management group. In the Southeast Outside District (east of 137 west longitude) shelf rockfish has been divided into two assemblages for management, demersal and pelagic, based on behavior and habitat. Pelagic shelf rockfish are a minor component of the nearshore longline fishery and are not currently a target species.

This report summaries the available information on the biology of demersal shelf rockfish and on the shore based rockfish fishery in the Southeastern Gulf of Alaska, including the internal waters of the Southeastern Alaska.

CATCH HISTORY

The history of domestic catches (mt) of demersal shelf rockfish are shown in table 2.

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Table 2. Reported landings of demersal shelf rockfish from domestic fisheries in Southeastern Alaska, 1982 - 1987.

	Southeastern Gulf of Alaska (EAST OF 137°)		
Year	Directed Landings	Incidental Landings	Total Landings
1982	160	79	239
1983	291	103	394
1984	736	62	797
1985	665	38	703
1986	900	110	1,010
1987	1,034	174	1,208

Source: ADF&G fishticket database.

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The peak catch of demersal shelf rockfish reported from the Southeastern region was 1208 mt in 1987. However this number should be considered an estimate since reporting requirements make analysis of species composition from fish ticket records somewhat unreliable. This is because the database includes landings of "unspecified red rockfish" and "unspecified rockfish" which may include species from other assemblages as well as demersal shelf rockfish. Data used in this report includes only landings reported by vessels using hook and line gear (longlines, jigs, troll). Catch is listed by calender year to be consistent with the INPFC report format, however, the State of Alaska manages the demersal shelf rockfish fishery based on a season which begins on October 1 and continues into the next calender year. Although there may also be some bycatch of demersal shelf rockfish in the Eastern Gulf trawl fishery for slope rockfish, no attempt was made to include these data as species composition information from the domestic trawl fishery is not available.

The Alaska Department of Fish and Game (ADF&G) has divided Southeast Alaska into five areas for rockfish management (figure 1). These areas represent the general geographic separation of the fleets from the various Southeastern ports, although ranges have begun to overlap as fishing pressure increases. The target fishery for demersal shelf

rockfish has expanded rapidly both in terms of landings and areas of catch. The fishery first developed in Sitka with the majority of landings coming from the Central Southeast Outside area (CSEO). By 1986 Ketchikan became the major port of landing with the 41% of the directed catch in Southeastern landed from the Southern Southeast Inside (SSEI) management area. By 1987 the fishery had expanded to the outer coast of southern southeast and 31% of the regional harvest was reported from the Southern Southeast Outside (SSEO) area.

Over 99% of the 1987 demersal shelf rockfish harvest was landed on longline gear. A total of 368 vessels reporting rockfish landings on miscellaneous finfish permits during 1987.

A 600 mt harvest limit was established for demersal shelf rockfish in the CSEO management area for the 1985 season by the NPFMC and the Alaska Board of Fisheries at a joint meeting in the fall of 1984. This harvest limit was based upon the anticipated 1984 harvest from the both state and federal waters in the CSEO area. This limit was intended to place a cap on rockfish harvests from that area until an appropriate yield level could be established. The 600 mt anticipated harvest level was not reached and only 521 mt were actually landed during 1984.

In 1987 the harvest limit (OY) for demersal shelf rockfish harvest (OY) was set at 1,250 mt for the Southeast Outside District. This limit was based upon an extrapolation which expanded the 600 t established for the CSEO area in 1984 to the remainder of the Southeast Outside District using a habitat comparison technique (Bracken 1986).

Based on fisheries performance indicators and available biological information, the Total Allowable Catch (TAC) limit for demersal shelf rockfish was reduced to 660 mt in the Southeast Outside District for 1988. The TAC is divided by ADF&G between the three outside management areas for in-season management.

CONDITION OF STOCKS

Analysis of commercial catch and effort data is difficult to interpret because of the dynamic nature of the fishery. Changes in market demand, gear technology, skipper proficiency and rapid turnover in the fleet confounds concise analysis. Additionally, since demersal shelf rockfish are reef oriented and the longline fleet very mobile, using CPUE data as an indicator of stock condition tends to underestimate the true level of stock decline (Francis 1985, Bracken and O'Connell 1986a). None-the-less, fishery performance indicators point to a significant decline in demersal shelf rockfish stocks in the CSEO area and may indicate reductions in the other management areas as well.

Relative Abundance

As stated earlier, the percentage of the total Southeast rockfish harvest taken in the CSEO area has declined dramatically since the peak harvest in 1984. More significant is the fact that the actual harvest from this area has decreased as well, from 521 mt in 1984 to 247 mt in 1987, a decline of 52%. It is important to note that the harvest level in this area was unrestricted during that time period and that rockfish markets remained strong throughout the region. During this period of declining catch levels in the CSEO area the Sitka fleet moved progressively further from port to maintain productive fishing. Similar shifts in effort have occurred in the two southern management areas as well. Given the four day limit on delivery from the first fishing day of fishing and the additional costs associated with lost fishing time and fuel consumption as the vessels travel further from port, this progressive expansion to more distant fishing grounds is considered to be a strong indication that the productivity nearer the ports has declined to the point where fishing is no longer profitable.

Catch per unit effort (CPUE) is measured in terms of pounds per landing. It is difficult to make definitive statements regarding CPUE as the fishery is in a constant state of change. Between 1983 and 1985 there was a shift from the use of primarily "j-hooks" to the nearly exclusive use of "circle hooks" (Bracken and O'Connell 1986b). Although no direct comparison experiments have been made for the rockfish fishery, the increase in efficiency of circle hooks was estimated to be two times that of j-hooks in the halibut fishery (IPHC 1987).

Change in skipper performance is hard to quantify and there is a high turnover rate in this fishery. For example, only 14% of the vessels that landed demersal shelf rockfish in 1987 had also participated in the fishery during 1982, only five years earlier. Also, changes in fishing grounds obscure actual declines in stock as CPUE may remain fairly constant over a wide area while localized depletion is occurring. Declines in average CPUE have occurred in the three most productive rockfish management areas in Southeast (Bracken and O'Connell 1986b). While inconclusive, these declines are cause for concern.

Absolute Abundance

A five year annual survey to assess the demersal shelf rockfish stock in CSEO was begun in 1987. The initial project involves testing of various sampling designs and therefore no estimates of relative or absolute abundance are expected from this project for several years.

Current Exploitable Biomass

Biomass estimates are not currently available for demersal shelf rockfish in the Gulf of Alaska. However, preliminary aging of key species indicates that most fish do not recruit to the fishery in Southeast Alaska until they are at least 25 to 35 years of age. Early

life history information is lacking and it is unclear whether the younger fish are absent from the population or are simply not available to the sampling gear being used. Work conducted by Rosenthal, et. al. (1982) suggest that there is a spacial separation by size and that the younger fish may be in depths shallower than normally fished.

Demersal shelf rockfish, being long-lived and slow-growing are "k" selective (Adams 1980; Archibald, Shaw and Leaman 1981; Gunderson 1980). These types of fishes are considered to be very susceptible to over-exploitation and are slow to recover once driven below the level of sustainable yield (Francis 1985; Leaman and Beamish 1984). For these reasons appropriate exploitation rates are assumed to be very low.

RECRUITMENT STRENGTHS

Length frequency and age distributions for yelloweye rockfish from commercial catch and research survey data are shown in figures 2 and 3 respectively. Length frequency data shows a strong mode at the 55 to 60 cm range. Age distribution shows several peaks with initial recruitment to the fishery occurring at between 30 and 35 years in the 1984 commercial catch data and at 25 years in the 1987 survey data from the CSEO area.

BIOLOGICAL PARAMETERS

Biological information is collected from the commercial catch through a port sampling program. Species composition and length, sex, and stage of maturity information is recorded and otoliths taken when possible for age determination. Shelf rockfish appear to stratify by depth, both in terms of species composition and size and age distribution within species. The smaller fish are generally found in shallower water (Rosenthal, et al 1982). Because commercial landings are usually comprised of fish from several depth zones no attempt has been made to analyze length frequency by depth from the commercial landings.

Yelloweye rockfish (Sebastes ruberrimus) is the primary target species for this fishery, accounting for at least 67% of the catch by weight ("unspecified red rockfish" which is assumed to be primarily yelloweye rockfish accounts for another 4.5%). Quillback rockfish (Sebastes maliger) is also important in terms of numbers of fish caught and accounts for 21% of the pounds landed.

Detailed biological parameters are presented only for yelloweye rockfish in this report although other demersal shelf rockfish are known to have similar life history characteristics.

Length frequency distributions for yelloweye from two of the more heavily fished areas in Southeast show a decline in average length over time (figure 2). The length distribution for Cape Edgecumbe in the CSEO management is are not directly comparable with the distribution from Cordova Bay in the SSEI management area at any given point in time since the SSEI fishery did not develop until 1984, two years later than the fishery in the CSEO area. Part of the observed change in average length over time may be due to increased market acceptance of small fish as the fisheries developed. Interview information reveals that some small fish were discarded at sea in the early years of the fishery, particularly in the SSEI area, although no data are available to determine the extent of this practice. Increased fishing pressure is likely to be the cause of at least some of the decline in the average length observed in recent years. For example, data collected from the CSEO area in 1981 yields mean lengths for yelloweye rockfish of 55.9 cm for the commercial catch (n=2183) and 59.2 for the survey samples (jigging machines, n=80) (Rosenthal et al 1982) compared to 51.8 cm for the commercial catch in the same area during 1987.

Sagittal otoliths are collected for aging. The break and burn technique is used for distinguishing annuli (Chilton and Beamish 1983). Age distribution from the commercial catch during 1983 and 1984 represents ages of 13 to 114 years with the first strong mode at about 35 years (figure 3). Age data from the CSEO area plotted separately reveals a younger average age and a lower first strong mode than the age data from all areas combined. This variation may be due to differences in landed catch between areas (at sea discard of small fish in the southern areas) or to differences in fishing pressure between the areas prior to 1984. Age distribution from the otoliths collected during the 1987 CSEO research cruise show a distinctly different age distribution with the first strong mode occurring between 20 and 25 years followed by a lesser mode at 35 to 40 years. These data suggest that the older year classes are being removed from the population thus compressing the age mode toward the younger fish.

Von Bertalanffy growth parameters calculated from the 1984 commercial catch data are shown in tables 2 and 3. For further information on age and growth refer to O'Connell and Funk (1986).

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Table 3. Growth parameters for S. ruberrimus in Southeast Alaska.

Sex	L	k	t_0	n
Male	64.628	.04798	-2.9985	257
Female	62.145	.05892	-3.3101	310

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Table 4. Length-weight relationships (cm-kg) for yelloweye rockfish in Southeast Alaska calculated from the equation $W = aL^b$.

Sex	a	b	n
male	.000023827	2.932887377	169
female	.000015348	3.056191748	108
gravid female	.000004348	3.396210000	63

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Mortality estimates were calculated using catch curve analysis on the 1984 commercial catch data (Ricker 1975). The southern area data was used as this stock was considered to be less heavily exploited in 1984. Mortality estimates were also calculated using Hoenig's formula: $\ln Z = 1.44 - .984 \ln (t_{max})$ where t_{max} is the maximum age (Pauly and Murphy 1982). These values are shown in table 7-4.

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Table 5. Natural Mortality estimates for S. ruberrimus in Southeast Alaska.

method	sex	M (estimate)
catch curve	male	.037
	female	.034
Hoenig's	both	.039 (t_{max} = 115)

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Demersal shelf rockfish are classified as ovoviviparous although recent work indicates that some species any be viviparous (Boehlert and Yaklavich 1984, Boehlert et al 1986). Rockfish have internal fertilization with several months separating copulation, fertilization and parturition. Within this ten species complex parturition occurs from February through September with the majority of fish extruding larvae in late winter and spring. Yelloweye rockfish extrude larvae over an extended time period with peak period of parturition occurring in April and May (O'Connell 1987).

MAXIMUM SUSTAINABLE YIELD

Information is not available to provide a direct estimate of maximum sustainable yield (MSY) for demersal shelf rockfish in Southeastern Alaska.

ACCEPTABLE BIOLOGICAL CATCH

Information is not currently available to provide an estimate of acceptable biological catch. However, fisheries performance indicators show continued declines at the present harvest level of approximately 600 mt in the Southeast Outside District. It appears that the harvest may be above the annual recruitment level and it is therefore assumed that the ABC is below 600 mt in that area.

BIOMASS PROJECTIONS

Declines in average size and age distribution of key rockfish species at present levels of harvest suggest that the current levels are not sustainable. Unless the harvest is reduced substantially it is likely that the demersal shelf rockfish stocks will continue to decline in the Southeastern area.

The Alaska Department of Fish and Game manages this fishery under a provision in the Gulf of Alaska Groundfish FMP. They will be submitting a proposal for harvest reductions to the Alaska Board of Fisheries for consideration at their January 1989 meeting. The suggested guideline harvest range for the directed fishery will be 300 mt to 420 mt for the Southeast Outside District. This represents a range of from 50% to 70% of the 1988 directed harvest of approximately 600 mt.

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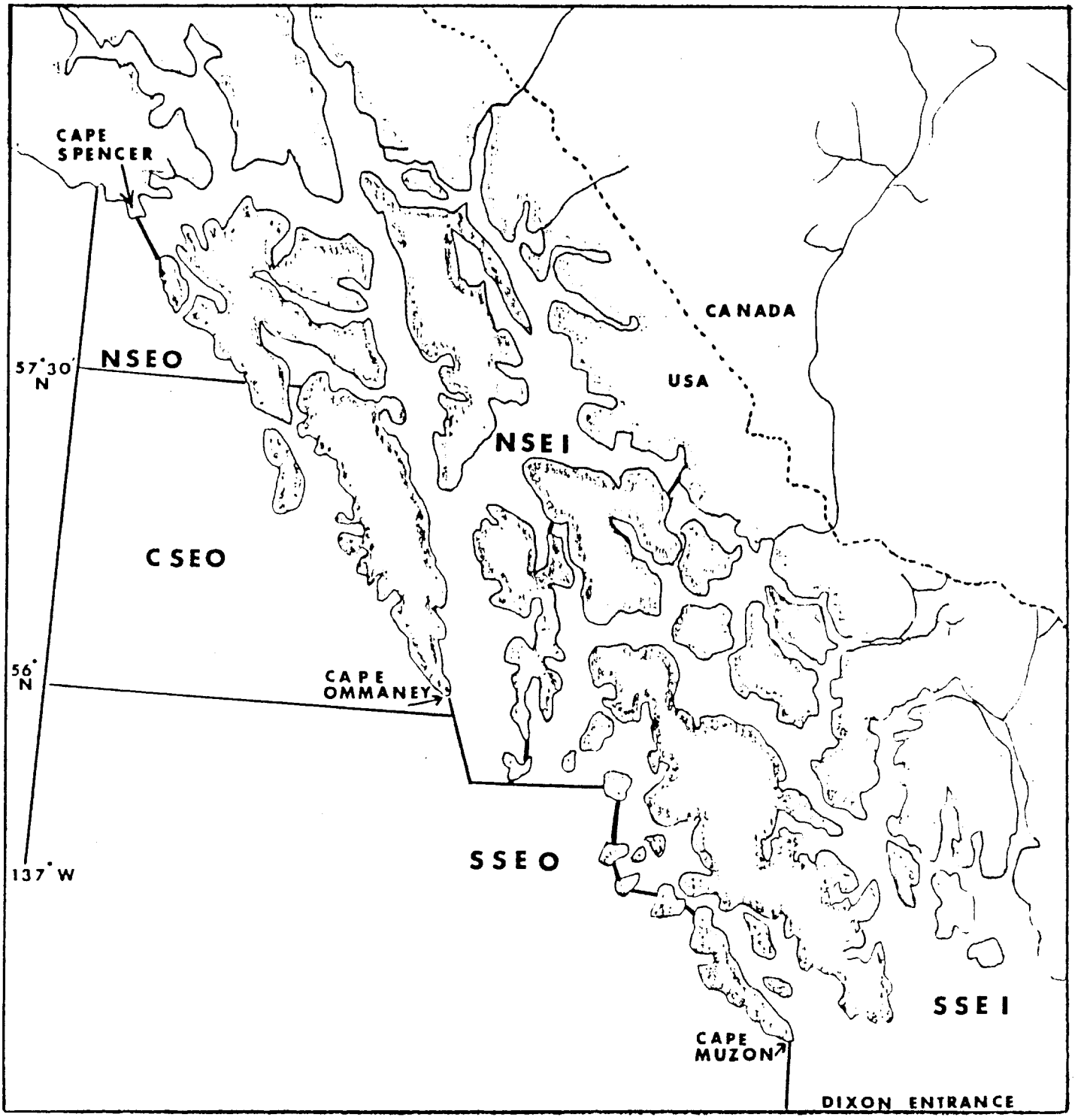

Figure 1. The Southeast Alaska coastline showing Alaska Department of Fish and Game groundfish management areas.

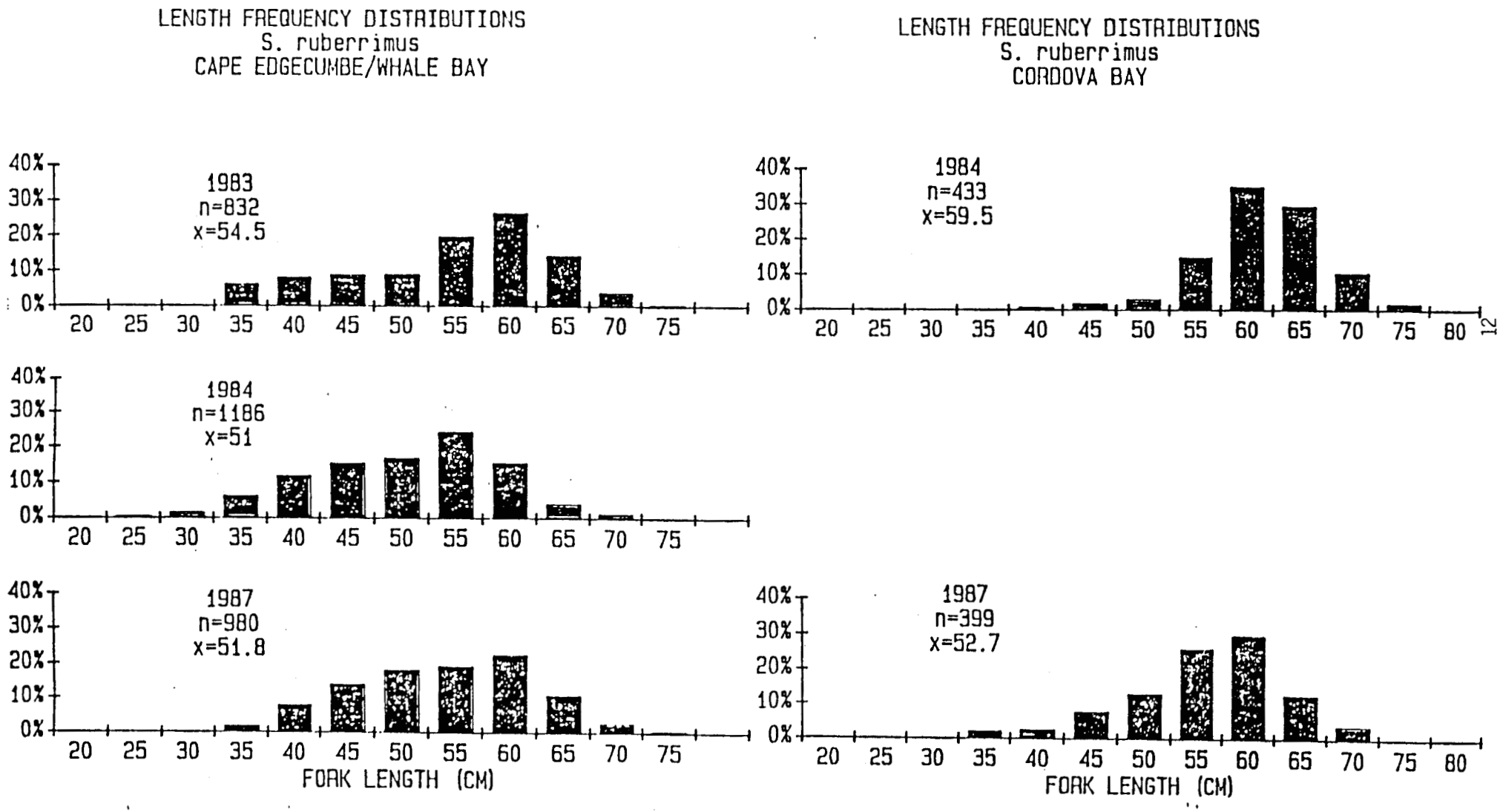

Figure 2. Length frequency distributions for yelloweye rockfish (S. ruberrimus) sampled from the commercial fishery.

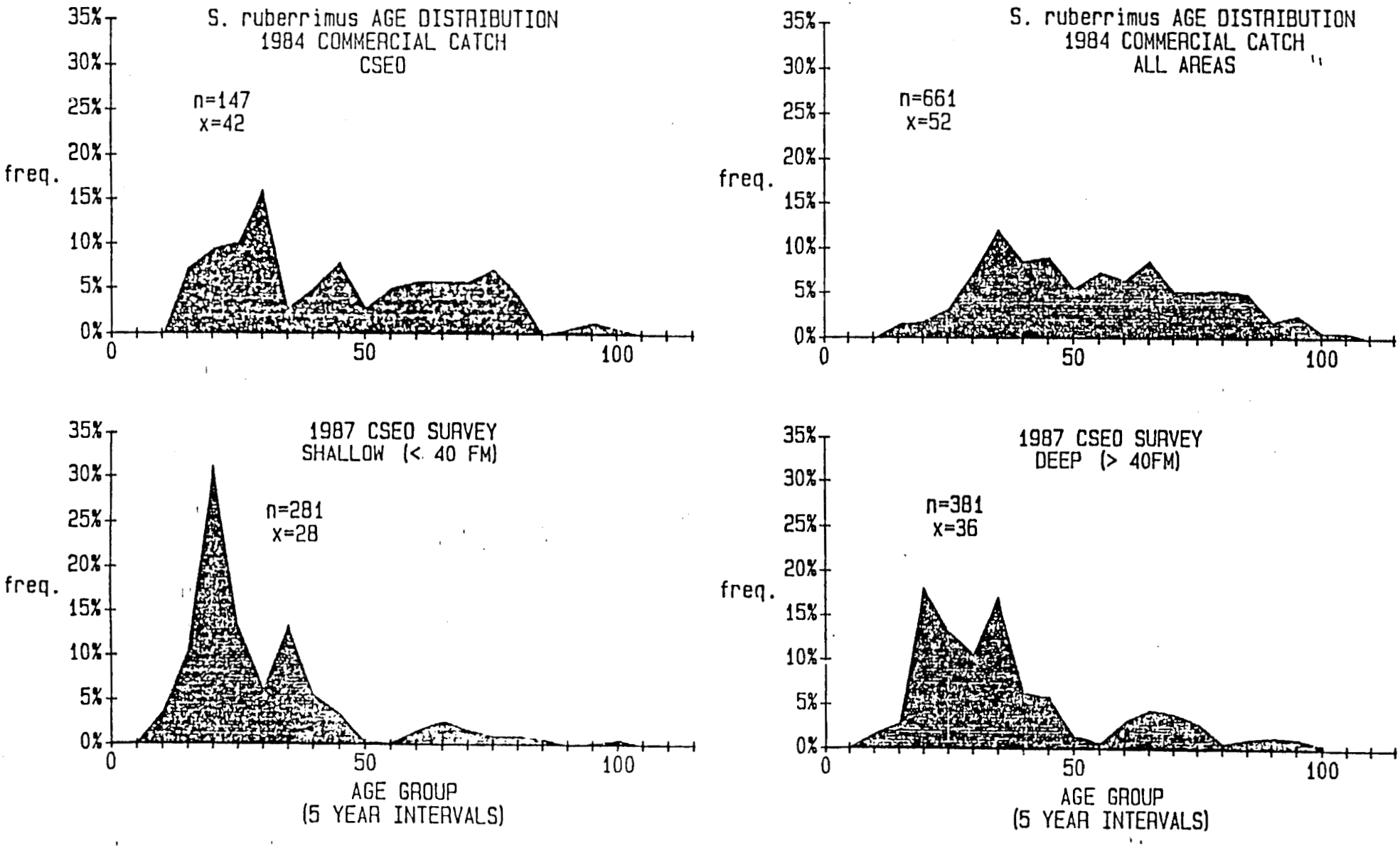

Figure 3. Age distributions for yelloweye rockfish (S. ruberrimus) from commercial catch and research survey samples (break-and-burn technique).